

**Cost and power consumption implications of digital
switchover**

Report

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Simon Karger
Jeremy Klein
Michael Reynolds
Ben Sales

Scientific Generics Limited
Harston Mill
Harston
Cambridge CB2 5GG

A Generics Group company

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Summary of key findings

- 1 At the time of switchover, our model predicts that around 10 percent of primary sets, 16 percent of subsequent sets and 10 percent of VCRs will need to be converted non-voluntarily due to the policy of switching over from analogue television to digital television according to the Government's announced timetable.
- 2 The total cost to UK households over the period of switchover of non-voluntary conversions driven by switchover policy is estimated to be £572m. This represents around 2% of all UK consumer spend on brown goods over the same period, which is forecast to be approximately £30bn¹.
- 3 Actual cost to individual households of switchover driven non-voluntary conversion of sets and VCRs is estimated to range from £26 - £153 depending on the equipment in the home and the status of voluntary conversion at the time of switchover. Where necessary, replacement of aerials is predicted to cost an additional £20 to £165 depending on whether there is a need to replace the roof aerial and on the number of new set top aerials required. However, as only around 2% of households are expected to require new roof aerials, the range of aerial costs for most households is likely to be from £20 to £40.
- 4 Typical household power consumption is expected to increase by 0.1 to 0.4kWh per day - an estimated cost of £2 to £8 per year at current tariffs. This is approximately equivalent to running a 60W light bulb for 1.5 to 6.5 hours per day.
- 5 The total anticipated peak additional power consumption in the UK as a direct result of switchover is expected to be around 31MWh per day (approximately equivalent to each UK household running a child's night light for around ten minutes per day). Over time, as older equipment is naturally replaced and technology becomes more power efficient, our model predicts that this will trend towards zero.

¹ "Consumer electronics in the United Kingdom", Euromonitor 2003

1 INTRODUCTION

This report and the associated model were commissioned by Ofcom to investigate the cost and power consumption implications of digital television switchover on UK households.

The switchover to digital television (DTV) has so far been primarily a voluntary transition. Penetration of television in the UK is very high, with TV playing an important role in most households. The switchover from analogue to digital transmission will therefore affect almost every household. As a result, it is considered necessary for Government and broadcasters to regulate and manage the switchover process. In order to maximise the likelihood of a smooth transition, Government, in consultation with industry and other key stakeholders, has announced a timetable for switchover over the period 2008 to 2012².

Progress towards full digital conversion has so far been rapid - Britain leads the world with 63% of households already having DTV on at least one set³. However, the switchover to digital will involve consumers converting not just one set but every reception device in their home (if they want to continue receiving TV in the way they do today). There are still an estimated 26m sets remaining to convert.

Whilst consumers will continue voluntarily to adopt DTV on some sets & recording devices, Government and broadcasters recognise that this alone will not lead to conversion of all the equipment necessary for switchover. Consumers will be required to convert some equipment that would not otherwise be converted in preparation for switchover.

This study focuses on those 'non-voluntary' conversions:

- Understanding the likely cost to UK households
- Determining the incremental change in the power consumed by households owing to the different power consumption profiles of digital equipment as compared to analogue devices.

This assessment does not take account of the distribution systems used in multiple occupancy dwellings or commercial properties. Nor does it consider costs that will not be borne directly by the household (i.e. the cost of support provided by third parties).

² "End for analogue as digital TV change 'shapes the future'", UK Government press release, 16th September 2005

³ "Digital Television Update", Ofcom, Q2 2005

2 BACKGROUND

Consumers' uptake of digital television (DTV) has been market led so far: those consumers who have been attracted by the offerings of one of the digital services (digital terrestrial, digital satellite or digital cable) have converted some of their televisions whereas those who are not attracted by any of the digital services have remained with analogue television.

According to Ofcom's latest Digital Television Update (Q2 2005), some 63 percent of households have DTV and this is growing at approximately 6 percent per year. The process of voluntary adoption of digital television is expected to continue. However, even with this level of voluntary take-up, some households will not have voluntarily switched their main television by the time of switchover in their region. To continue to be able to watch any television at all they will need to change to a digital service. In effect switchover will mean that they have little choice other than to convert their regularly used equipment. The cost to consumers of making these non-voluntary changes is understandably a matter of public interest.

To fully switch, each television in a household would need to be converted. At present, many households have converted their primary television but not their subsequent sets. The voluntary conversion of subsequent sets is occurring but will not be complete by the time of switchover. So, in order to continue to be able to use these subsequent sets to watch television programmes, households need to convert them. Not all subsequent sets will be ever be converted: some sets may only be used occasionally to receive a live TV broadcast and households may decide not to convert them. Notwithstanding, there will be a level of non-voluntary conversion of subsequent sets, and there will be an associated cost to consumers.

In some households, video cassette recorders (VCRs) will also need to be converted. The situation with VCRs is not clear cut. Some VCRs currently in use will have broken down and have been replaced by the time of switchover. New recorder technologies such as digital PVRs and recordable DVDs are already being purchased for use in place of VCRs and the pace of these purchases is expected to increase. Furthermore, analogue VCRs will still be usable after switchover to record the channel being watched on the television set and for playback of pre-recorded content. They will not, however, be able to record a different channel to that being watched without additional converter equipment. For these reasons, research has shown that the majority of VCRs will not need to be converted. Nevertheless there will be a proportion that does, and these will give rise to costs for consumers.

To complete the picture of consumer costs, aerials and cabling may also need to be changed. After switchover the transmission power levels will increase and will make reception easier in some places— removing the need for new aerials in places where they are currently necessary. Some element of consumer cost in respect of aerials will be unavoidable, however.

The extra equipment that people are forced to acquire will draw power, even when placed in standby mode. The cost of this extra electricity represents a further possible cost for consumers and, in aggregate, could represent a significant source of extra electricity demand for the UK. Conversely, digital switchover will reduce the electricity consumption of TV transmitters, thereby reducing the overall increase.

This study calculates the potential cost and power implications of Government's switchover policy on UK households. Our method is platform neutral: households are able to convert their equipment to digital by adoption of any suitable and available platform. However, for the purposes of estimating the potential cost of switchover policy, where a conversion is not made voluntarily, it has been assumed that the lowest cost option has been selected by the household as switchover approaches. Where available this has been assumed to be DTT and where DTT is not available, free to view satellite has been assumed.

3 TYPES OF CONVERSION

3.1 The regional switchover timetable

On 16th September 2005 Government published a timetable showing switchover occurring between 2008 and 2012 depending on region⁴. Table 1 shows the timetable as published.

Table 1 - Government switchover timetable by region

Switchover date	Region	Switchover date	Region
2008	Borders	2011	Yorkshire
2009	West Country		Anglia
	HTV Wales	Central	
	Granada	2012	Meridian
2010	HTV West		Carlton / LWT
	Grampian		Tyne Tees
	Scottish		Ulster

By phasing the switchover of each region, non-voluntary conversions are effectively staggered over a four year period. Staggering conversions in this way means that later conversions will benefit from technological advances (including those relating to power management) made in the intervening years. Further, these households will benefit from ongoing price erosion due to technology development and economies of scale as the pan-European market for conversion builds. Staggering in this way will also smooth demand, and reduce pressure on the supply chain.

To ensure that it appropriately takes account of these dynamics our model addresses each region separately.

3.2 Consumers' responses to the switchover timetable

When considering switchover, the population of TVs and other reception equipment in the UK can, at a high level, be split into two groups⁵: those that will be converted to digital irrespective of switchover (*voluntary conversions*); and those that will only be converted as a direct result of the switchover policy (*non-voluntary conversions*). It is the latter of these (those required to convert as a result of policy) that is the primary focus of this assessment.

⁴ "End for analogue as digital TV change 'shapes the future'", UK government press release, 16th September 2005

⁵ Some subsequent sets and VCRs may not be converted and may be retained for use with non-broadcast equipment such as electronic games, or may be disposed of.

3.2.1 Voluntary conversions

A '*voluntary conversion*' is defined as the conversion of a TV set driven by the user's desire to access DTV on that set. Critically, this decision has been made independently of switchover policy. A voluntary conversion can be made at any time by either adding a cable, satellite or DTT set top box (STB) to existing equipment, or by replacing that equipment with a digital alternative. In the instance where a set was planned for conversion, but that conversion is brought forward to meet the Government's switchover timetable, the conversion is considered to remain a voluntary one. There is no net incremental cost to the household⁶.

Our model estimates that around 90% of primary sets and 50% of subsequent sets will be voluntarily converted. This estimate is based on previous Generics Group studies carried out for the DTI and DCMS⁷ and is in line with the top end of conclusions formed in these studies. This latest assessment brings these conclusions up to date, making adjustment for the higher than anticipated growth of DTV observed since our last survey⁸ and the anticipated increasing availability of integrated digital televisions (iDTVs) in the UK market as switchover approaches.

3.2.2 Non-voluntary conversions

A '*non-voluntary conversion*' is defined as the conversion of equipment which would not have been converted had analogue transmissions been set to continue in perpetuity. Our model predicts that around 10% of all primary sets and 16 percent of subsequent sets will be subject to non-voluntary conversion.

These conversions are expected to be prompted by increasing consumer awareness of impending digital switchover. We expect the non-voluntary conversions to be concentrated into the final two years before switchover in each region. The majority of these conversions will occur in the year of switchover.

In some instances, it is recognised that the conversion of a set may have other implications (i.e. the replacement of a roof aerial or the connection of a subsequent set to a roof aerial feed). Where this is the case, these implications – and the resultant costs – are considered to be a direct implication of switchover and in themselves 'non-voluntary'.

⁶ There might be a small difference in price between the cost of an STB at the two points in time

⁷ "*Attitudes to Digital Switchover: The impact of digital switchover on consumer adoption of digital television*", DTI, March 2004

⁸ "*Digital Television Update*", Ofcom, Q1 2004 – Q2 2005

3.2.3 VCRs

Conversion of VCRs is a complicated issue. Whilst in many cases conversion of a set can allow recording of DTV by a VCR (via a second SCART), the functionality of the VCR is significantly reduced. Critically, the ability for the VCR to independently record a channel (i.e. record a different channel to that being watched) or control the channel being recorded (i.e. allow time shift recording) is lost. Whilst this may be acceptable to some households, many others will need to consider how to convert a VCR and maintain these capabilities. Currently, this can be achieved in two ways: installing an STB dedicated to the VCR or replacing the VCR with a digital recorder (PVR or DVDR).

Given the products available today, installing a dedicated STB for use with a VCR is not considered to be a practical option. The usability challenges of such a set-up are expected to exclude a high proportion of users⁹. Industry interviews have confirmed this view, and whilst it is recognised that VCR conversion options may improve, this will not become a common conversion option. Therefore, the normal solution by which a VCR can be converted and full functionality maintained is through being replaced by a digital recorder.

For the purposes of our modelling, the population of VCRs needing conversion is taken to be those that are used for independent recording as defined above, rather than all VCRs. Further, a non-voluntary conversion can be taken to apply only where a VCR would not otherwise be replaced, and it is currently used for time shift recording on a regular basis (more than once per month). Our model estimates this to be around 10% of all VCRs.

This established, the same definitions of 'voluntary' and 'non-voluntary' described for TV sets can also be applied to VCRs.

⁹ "Digital television for All", DTI, September 2003

4 PLATFORM SELECTION & HOUSEHOLD EQUIPMENT

There are currently four platforms through which a consumer can receive DTV - DTT, Satellite, Cable and DTV over DSL. However, as shown in Figure 1 the penetration of DTV over DSL is currently extremely low. It has therefore been excluded from this study.

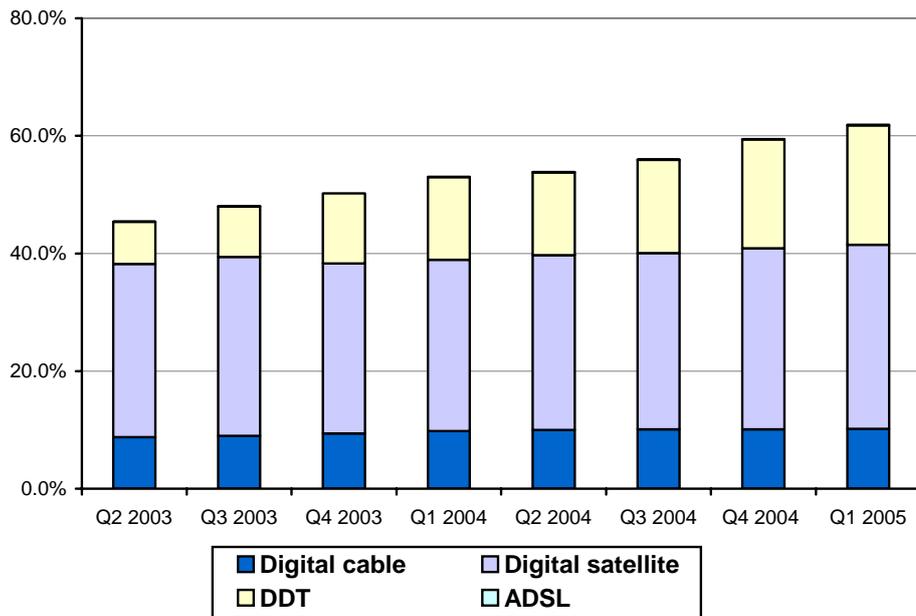


Figure 1 - Historical penetration by platform (Source: Digital Television Update, Ofcom, Q1 2005)

4.1 Platform selection

As conversion to date has been wholly voluntary, platform selection has been driven by different factors for each viewing household and indeed for each device in the home. However, some common factors include: availability, cost and the attractiveness of the services on offer.

Whilst the model is focused on non-voluntary conversions, it necessarily has to also cover voluntary ones to be sure of giving a complete picture. Within the model, platform selection for voluntary conversions is assumed to be in line with published forecasts of platform share of installations¹⁰.

In the future, ongoing voluntary conversions will be supplemented with the new, non-voluntary ones. In these cases existing research shows that the choice of platform is dominated by cost and that (for subsequent sets) the selected platform

¹⁰ "Driving Digital Switchover: A report to the Secretary of State", Ofcom, April 2004

may differ from that installed on the primary set¹¹. For the purposes of the cost model, it is therefore assumed that all non-voluntary set conversions will make use of the lowest cost route to conversion available. In most areas this will be via a low cost DTT STB. Should DTT not be available due to coverage limitations, free to view (FTV) satellite has been assumed.

4.2 Platform availability & reception

Platform availability, specifically relating to DTT and free to view satellite is a driver of the minimum cost of conversion to DTT.

4.2.1 DTT coverage

In the years before switchover occurs, DTT coverage is limited to approximately 73% of the population¹². This provides lower coverage by the Public Service Broadcasters (PSBs) than is the case with existing analogue transmissions. DTT coverage is limited by the necessity to transmit at a reduced power in order to avoid interference with the analogue transmissions. However, once switchover has taken place, the power of digital transmissions will be increased resulting in a coverage equivalent to that of current analogue transmissions (around 98.5% of households).

The implications are that some households will not be able to receive DTT signals until switchover has taken place. For the purposes of understanding the impact of policy driven switchover, we have taken the coverage that will exist after switchover. Should a household that is outside pre-switchover DTT coverage wish to receive DTV before switchover, any costs additional to those required in post-switchover conditions are considered to be voluntarily incurred.

4.2.2 Free to view satellite

Whilst DTT will, after switchover, provide access to the PSBs without subscription for the vast majority of the UK population, there will always be some who cannot receive sufficient signal. For these households, free to view satellite will be the main low cost option. Free to view satellite is in its infancy in the UK with Sky providing the only platform offering access to all of the PSBs. The Sky service will require consumers to have a professional Sky installation as well as to purchase a decoder card in order to receive the free to view service.

In September 2005 the BBC and ITV announced¹¹ plans to launch an unencrypted free to view satellite offering to compete with the subscription free Sky service. This will allow viewers to receive the BBC and ITV channels by purchasing a satellite dish and STB independent of Sky, the need for Sky-specified installation

¹¹ Generics CAPI dataset, v13, 2004

¹² "DTT Coverage Using Existing Aerials/Domestic Equipment", Spectrum Planning Group, September 2002

or any decoder cards. The details and costs of this new service are not yet announced. For the purposes of this study (whilst the model allows for either a Sky or an 'in the clear' market to be considered), it has been assumed that the costs of a free to view satellite installation will be equivalent to the current Sky offering.

4.2.3 Aerial replacement

Prior to switchover, approximately 30% of households are likely to require new rooftop aerials to receive DTT transmissions¹³. When switchover occurs and transmission power is increased, it is estimated that only 10% of households will actually require replacement aerials¹⁴. Given that our model predicts only around 10% of UK households needing to non-voluntarily convert their primary sets, the 10% of aerials requiring replacement will only apply to this subset of households (i.e. 1% of UK households). Further, we recognise that there is likely to be some cost driven skewing of these non-voluntary households (i.e. households not voluntarily converting because of the extra cost of replacing their aerials). To account for this, we have applied a factor of two to the households needed to non-voluntarily convert their roof top aerials. Therefore, a figure of 2% is used in our model.

Where a new aerial is not required to receive DTT after switchover, replacement of an aerial in order to receive DTT prior to switchover is classed as a voluntary cost.

Research has shown that set top aerials are in common use throughout the UK. Whilst only 4% of primary sets rely on set top aerials, approximately 26% of subsequent sets use them¹⁵. Whilst some areas cannot currently receive DTT through set top aerials, this is limited by the same power factors affecting roof top aerials. It has therefore been estimated that approximately 50% of set top aerials will not reliably receive DTT after switchover. Where a set top aerial is no longer sufficient to receive DTT after switchover, the cost of additional internal wiring (in the case of a subsequent set) or a new roof aerial (in the case of a primary set) has been taken into account in the cost model.

4.3 Equipment in the home

A household can contain a wide variety of audio visual equipment. For the purposes of this study we only include viewing equipment (TV sets) and recording equipment.

¹³ "Go Digital", ITC, 2003

¹⁴ Ofcom estimates

¹⁵ Ofcom research on portable set top aerials, 2005

4.3.1 TV Sets

We have assumed that all households included in the model have at least one TV (their primary set). A household may in fact have multiple TVs. The TVs in a household beyond the primary set are grouped as 'subsequent' sets and have been shown in previous studies^{16,17} to be subject to different rules during the household conversion process. As a result, these subsequent sets are addressed separately in the model.

Within the population of sets, previous studies have shown that 1.3% of primary sets and around 29% of subsequent sets will not be used for viewing live TV or will not be used at all after switchover. These sets are typically used solely for playback of recorded media or connection to games machines etc or are currently used very infrequently. It is assumed that these sets will not need converting to digital.

4.3.2 Recording devices

Surveys carried out in numerous previous analyses have shown that whilst many households have multiple analogue recording devices (typically VCRs, but may also include analogue PVRs or DVDRs), often only one of these is used for recording with the rest being used for playback only^{16,17}. For the purposes of understanding the policy driven implications of switchover, any recording devices that are used only for playback or recording the same channel as is being watched will not require conversion to maintain functionality. It is recognised that many of these sets may be converted or replaced, however this is not seen as being a result of policy and therefore are considered to be voluntary. Therefore, our model accounts only for those analogue recording devices that are regularly used for 'independent' recording (i.e. timer recording or recording a channel other than that being watched) more than once a month.

¹⁶ "Go Digital", ITC, 2003

¹⁷ "Attitudes to Digital Switchover: The impact of digital switchover on consumer adoption of digital television", DTI, March 2004

5 THE COST OF DIGITAL EQUIPMENT

5.1 The current costs of equipment

As part of this study, we carried out a series of cost & power assessments on typical digital equipment (see section 6.1). These have been used to establish typical costs for digital equipment in today's market (see Table 2)

Table 2 - Typical costs of digital equipment¹⁸

Equipment	Cost
Freeview STB	£50
Incremental cost of iDTV	£100
Sky free to view installation	£150
Sky pay installation & subscription (1yr)	£240
Cable installation & subscription (1 yr)	£210
'In the clear' FreeSat installation	£100
Digital recorder	£107
New roof top aerial installation	£125
New feed to an existing roof aerial	£50
New digital set top aerial	£20

5.2 Drivers of cost reduction

The main cost elements of a Freeview STB are the silicon. The typical low cost (converter) box contains the following key elements:

- Tuner Module chip
- Modulator
- Power supply
- DVB-T demodulator chip
- Digital STB chip
- Flash memory
- RAM memory chip.

The majority of these components are mature and are not likely to be subject to significant change over the next 5 years.

¹⁸ Equipment costs from review of prices from suppliers and/or a range of retailers and aerial installers

The four main chips (the digital STB, RAM, demodulator and tuner module), however, are less mature. In all cases, these appear to contain quite large pieces of silicon so the trend to higher levels of integration as technology improves will apply. We would expect the merging of some of these components as technology improves. This will reduce their cost and power consumption.

The largest chip is the digital STB chip. This device has a lot of functionality that is common to all types of Digital set top box (Terrestrial, Satellite and Cable, basic converter, interactive and PVR/DVR). This broad applicability drives high volume sales and so keeps costs down.

The most obvious first step is integration of the RAM memory onto the STB chip as this is required for all applications of this chip. The barrier to this is flexibility. The amount of RAM needed varies with the functionality of the box and with the broadcast specifications. This integration will only occur once the volume of a particular variant type of STB chip is high (several million p.a.). This will take more than UK demand for DTT converter boxes to drive. Nonetheless, common requirements across all digital platforms for the UK could make this happen. In practise this improvement is already being delayed. One manufacturer is adding MPEG 4 decoding required for other markets first, so maintaining the wide applicability of these chips.

A similar step is to merge the STB chip and the DVB-T demodulator. Again this will require significant market demand for DVB-T set top boxes. Again we anticipate this needing more than UK demand to stimulate. Some manufacturers have this on their roadmaps already. The other change that is likely to occur is the switch from Flash memory, which is required to allow over the air software update, to ROM memory which is lower cost but cannot be updated in the field. This will only happen once the specification has been stable for a few years. The spec is not seen yet as stable by some manufacturers (Impending upgrades to the EPG for example).

Further, the accepted trend for semiconductor devices is a halving of costs over 18-24 months for the core silicon. In addition to this there is a fixed cost per device of about 50p to cover packaging and test costs.

We model the remainder of the electronics with a cost declining with the industry trends over the past 5 years:

- HDD cost is £40, the trend is for capacity to go up rather than cost going down
- DVD writer costs are the same, with cost trends likely to be the same as for HDDs.

5.3 Forecast equipment costs

As a result of declining equipment costs, the cost of non-voluntary conversion of sets in a household will depend not only on the equipment being converted, but also on the timing of switchover in their region.

Figure 2 - shows the anticipated cost of a Freeview STB and digital recorder over the period of switchover.

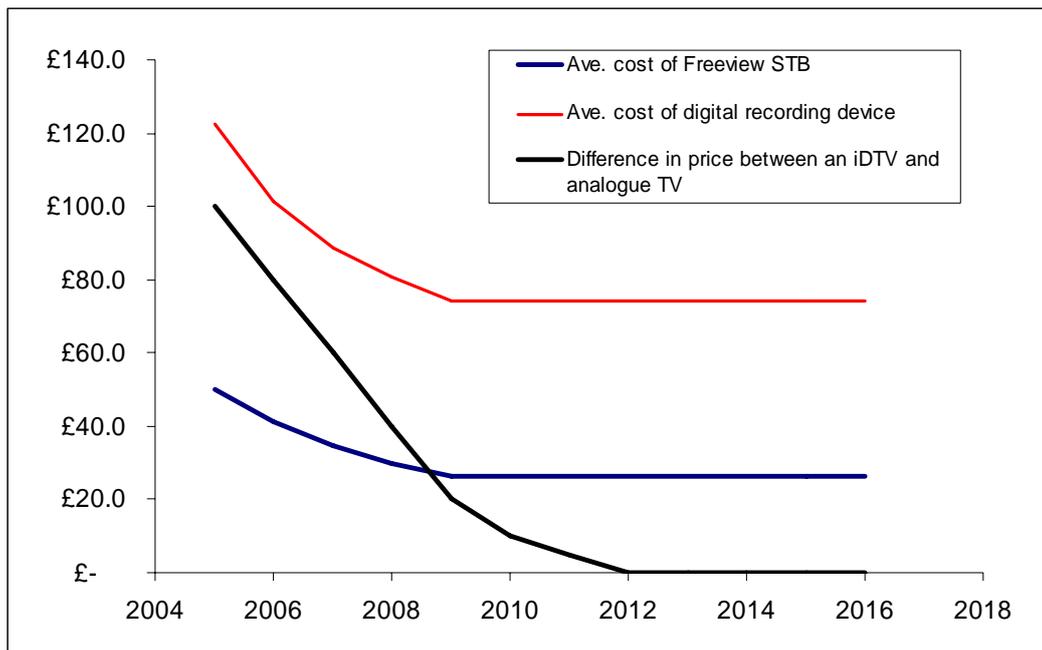


Figure 2 - Typical digital equipment costs

The data shown in Figure 2 - is based on a, £50 Freeview STB at the time of analysis (mid 2005). Our analysis forecasts the common availability of a £25 DTT STB by the time of switchover. This is in line with other studies¹⁹ and seems reasonable given the presence of £35 STB on market the today. In reality it is recognised that there will be a range of equipment available, offering varied functionality at a broad spread of costs. To predict the cost of switchover however, our model assumes that a least-cost route to conversion is taken based on the costs in Figure 2 - .

¹⁹ "Supporting the most vulnerable consumers through digital switchover", Ofcom Consumer Panel, November 2004

6 THE POWER CONSUMPTION OF DIGITAL EQUIPMENT

6.1 Power consumption of existing equipment

To ensure that the power consumption elements of the model accurately reflect the real world power consumption of typical equipment, a testing programme was carried out as part of this work. The operating and standby power consumption of a range of typical STBs and recording devices was established using a laboratory power meter. All testing was done in the home (rather than a laboratory) environment. Table 3 shows details of the equipment tested and test results.

Table 3 - Equipment tested and power consumption recorded (* Where available)

Model	Best Price (£)	Manufacturer claim		Measured	
		Max power (W)	Standby power (W)	Operating power (W)	Standby power (W)
DTT STB					
STB 1	50	12		10	10
STB 2	30	11	9.5	10	9
STB 3				11	10
STB 4	80			13	12
STB 5	-	8	<1	10	<0.1
STB 6	-	8	<1	10	<0.1
STB 7	-	8	1	7	<0.1
STB 8				17	17
STB 9	100	24	5	9	9
STB 10	83	10		9.3	5.2
STB 11		24	5	9.7	6.2
DTT PVR/DVR					
PVR 1	160			24	18
PVR 2		30	5	22	12
DTT DVD-R					
DVDR 1	287		5	37	6
Freeview VCR					
FV VCR 1	80			18	11
Satellite / Cable					
Satellite 1				12	11
Cable 1				26	25
Satellite 2		60	9	20	13
Analogue VCR					
VCR 1			9	12	4
VCR 2				22	7
VCR 3				22	8
VCR 4				32	11

6.2 Drivers of changing power consumption

The testing work carried out provides an accurate view of the power consumption of equipment today. This, along with industry interviews, has been used as the basis for forecasting the likely power consumption of equipment in use over the switchover period. There are two separate issues here: operating power consumption and standby power consumption.

6.2.1 Operating power consumption

Operating power consumption is expected to decrease with time for two reasons:

- As transistors get smaller in highly integrated chips they take less power
- As chips merge less power is used in the interconnects between them.

The second of these effects is larger and in a set top box the integrating of the RAM with the STB chip will have a significant effect.

6.2.2 Standby power consumption

Whilst power consumption when not in use (in standby mode) may be thought to be minimal, there are actually several functions that may still be required:

- Maintaining and monitoring the time ready to turn on for a timer record (when linked to a video recorder).
 - We estimate that the power required for this function is less than 1 Watt.
- Checking for over the air software updates
 - The power required for continuous checking is similar to the operating power, however software updates are normally transmitted for at least 24 hours. There is no reason the STB should not wake up with the timer once every 24 hours and check for an update (for say 1 hour). Indeed some STBs in the market already do this. This reduces the power requirement to about 4% of normal operating
 - Checking for access control messages where a conditional access system is used
 - The power required for continuous checking is similar to the operating power. This could be reduced with smart protocols but these would require cross industry change to implement.

For a simple adapter STB this set of functions is expected to require no more than 2W when in standby. As a result, there is no technical reason why the standby power consumption should exceed the EU code of practice of 2W. Currently, we note that a large number of these types of STB do exceed the EU code of practice. Without legislative pressure, there is little motivation for

manufacturers to take further account of power consumption, especially whilst the sector remains so price conscious.

6.3 Forecast power consumption

As a result of our analysis of STB hardware and anticipated equipment development, we expect the power consumption of a typical £50 DTT STB to fall from 10W today to 3W in 2012, as shown in Figure 3 - .

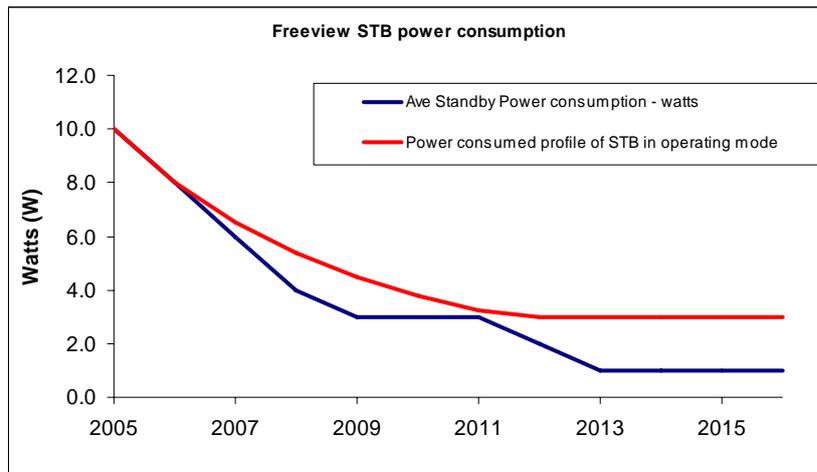


Figure 3 - Changing power consumption of a DTT STB

Figure 4 - shows the same for digital recorders and includes a comparison with analogue VCRs. This shows that in 2010, the power consumed by a digital recorder will become lower than that consumed by a VCR.

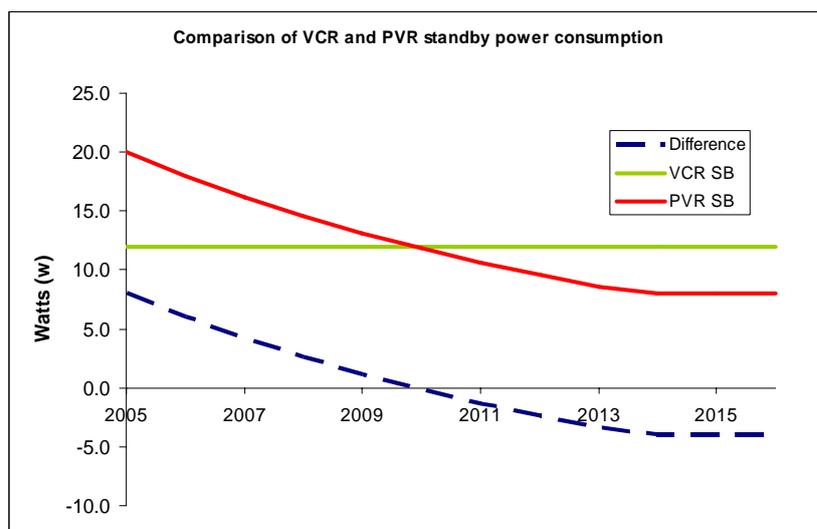


Figure 4 - Power consumption of a digital recorder against an analogue VCR

7 THE CONVERSION PROCESS

This study has modelled the expected voluntary and non-voluntary digital conversion activities by region as switchover approaches. Informed by equipment testing, previous studies and industry interviews we have modelled the way in which equipment costs and power consumption will develop over the next nine years. These data have then been used to understand the cost and power consumption implications of switchover policy to a typical UK household.

To fully reflect the impact of a phased, regional switchover timetable and of the variety of households in the UK this section of the report will consider the impact of switchover on a set of five typical households in three regions.

7.1 Regional switchover

With switchover being phased across a period of approximately five years, those households converted later in the process are expected to additionally benefit from the economic and technological developments that will take place in that time. Specifically, as the volume of sales grows (driven by switchover), so the price of a box is expected to fall. At the same time, as technology develops, the power consumption of boxes is expected to fall. With the majority of non-voluntary conversions happening in the final years before switchover, the cost of these conversions will be heavily influenced by the switchover timetable.

To reflect the effects of this when we consider the household impact of switchover, we have considered three locations: Borders, Birmingham and Ulster. These locations have been selected because of their expected switchover dates. Borders (2008) and Ulster (2012) represent early and late regional switchover areas whilst Birmingham (Central region – 2011) represents a typical urban population converting mid way through the national switchover programme.

Table 4 shows the proportion of each equipment type that will be required to convert as a direct result of switchover in each region. These proportions take account of:

- Voluntary conversions
- Equipment that will not be required to convert (i.e. TVs used only for games, non-independent recorders etc)
- Equipment that will not be converted by choice (i.e. that will not be used after switchover).

Table 4 - Proportion of equipment required to non-voluntarily convert by region

Equipment	% required to convert		
	Borders (2008)	Birmingham (2010)	Ulster (2011)
Primary sets	12.6%	8.2%	6.4%
Subsequent sets	20.9%	16%	13.6%
Recording devices	10%	10%	10%

7.2 Example household profiles

In order to assess the impact of switchover policy on a range of households, we have defined five typical household profiles of relevance to Ofcom in Table 5

Table 5 - Household types

Household type	% of UK households
Single occupant(including households with a single, retired inhabitant)	31%
Retired couple	12.3%
Family with young children (4-9 years)	8.5%
Family with teenage children (9 – 14 years)	9.4%
Low income ²⁰ family with teenage children (9 – 14 years)	1.5%

These profiles have been selected to reflect typical households in the UK that contain a spread of different equipment and so may be most impacted by the cost and power consumption implications of switchover. Together these represent 59.2% of households. The remaining 40.8% is made up of working couples (19.7%) and other household types such as shared houses etc. These profiles provide a meaningful framework around which to investigate the cost and power consumption implications of switchover.

7.2.1 Sets by household

Figure 5 shows the distribution of household profiles by the number of sets they contain. As would be expected, as the number of people in a household and the age of children increases, so does the number of sets. An exception to this is

²⁰ Low income defined as a household with combined income less than £11,500

seen in low income households who typically appear to have a fewer number of sets. Figure 6 shows the average number of sets per household type.

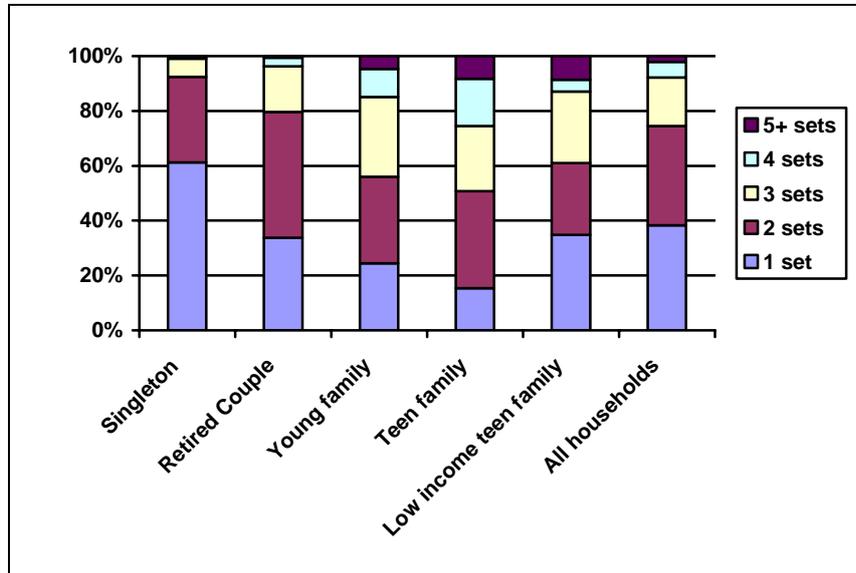


Figure 5 – Number of sets per household type

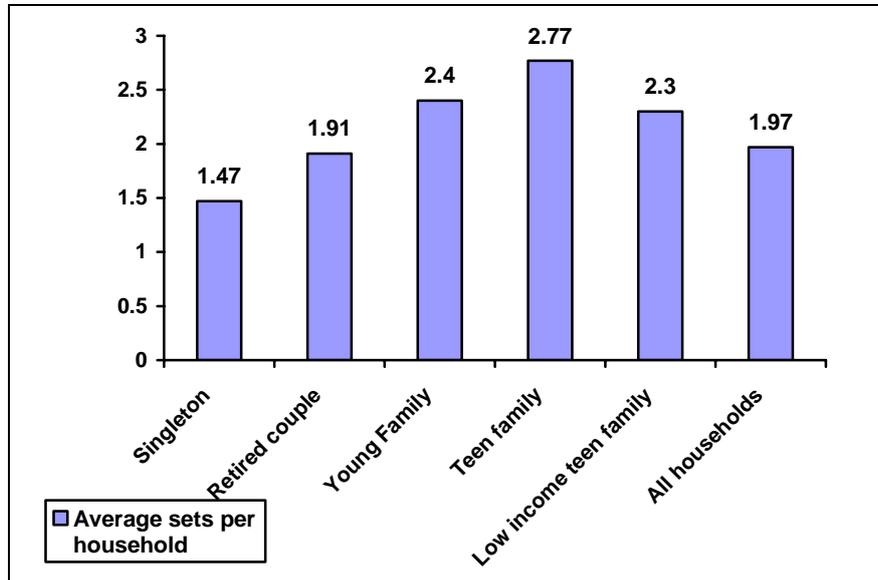


Figure 6 - Average sets per household type

7.2.2 Recorders by household

Figure 7 and Figure 8 show the distribution of recording devices in the home by household type and the average number of recorders respectively.

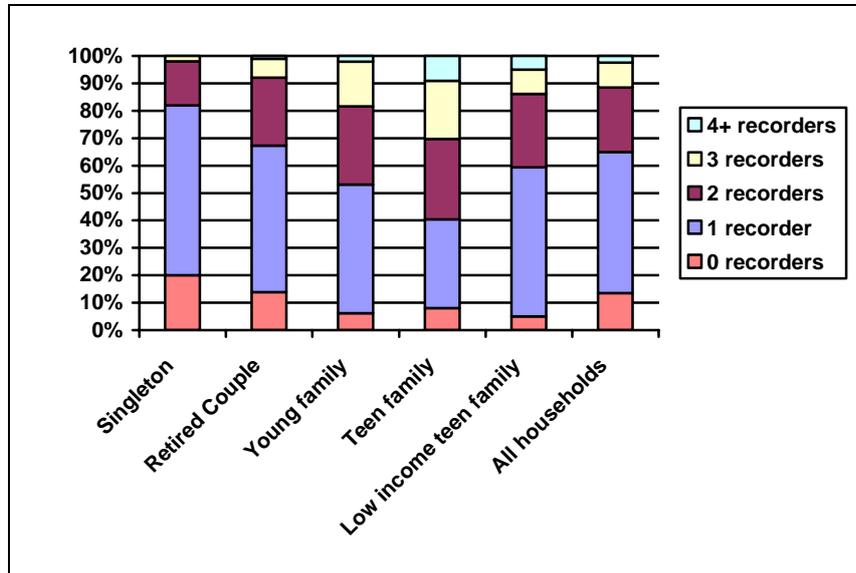


Figure 7 - Total number of recording devices per household type

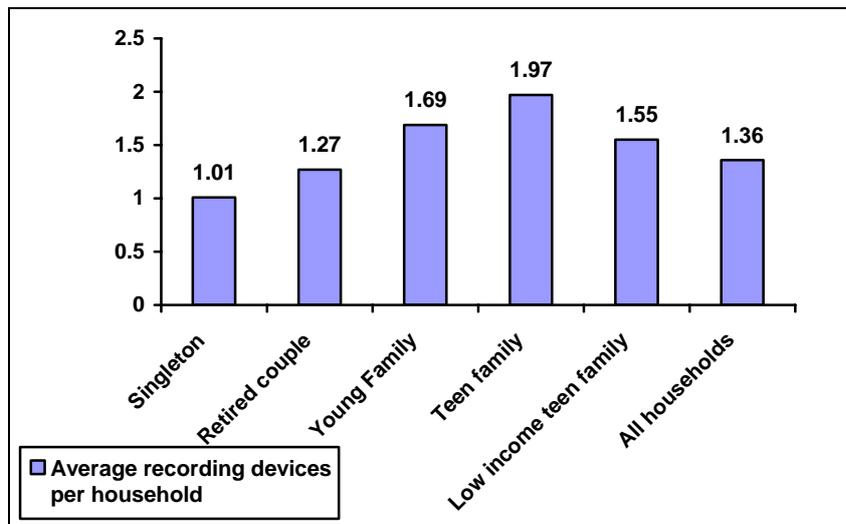


Figure 8 - Average number of recording devices per household type

However, for the purposes of understanding the implications of switchover, it is recorders used for independent recording at least more than once per month that are of interest. An independent recorder is defined as one used to record either a channel other than that being watched, or in a situation where the recorder device may be required to control the channel being recorded (i.e. when the timer is being used). Other modes of usage (i.e. manual one-touch recording, playback etc) do not require a recorder to be independently converted as these functions are still available if fed from the TV converter.

Figure 9 shows the average number of independent recorders per household type.

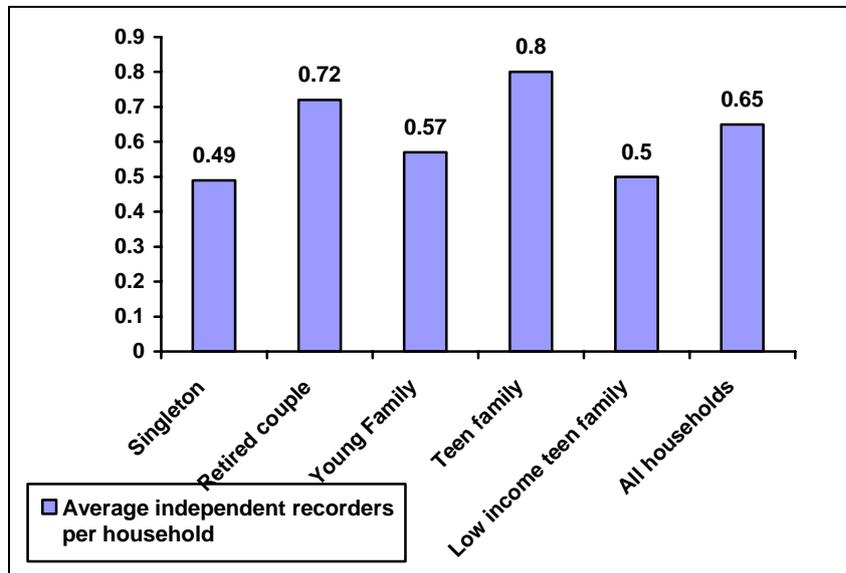


Figure 9 - Average number of independent recorders by household type

7.2.3 Summary of household equipment

From Figure 6 and Figure 9, the average amount of equipment owned by a household belonging to each profile is shown in Table 6. In order to make later cost estimates realistic, these average figures have been rounded up to the nearest whole set or recorder, as shown in Table 7. These data form the basis of later cost calculations.

Table 6 - Average equipment owned by household profile

Household profile	Average equipment owned by household	
	TV sets	Independent recorders
<i>Single occupant</i>	1.47	0.49
<i>Retired couple</i>	1.91	0.72
<i>Young family</i>	2.40	0.57
<i>Teen family</i>	2.77	0.80
<i>Low income teen family</i>	2.30	0.50

Table 7 - Rounded whole number of sets & independent recorders in an average household, by profile

Household profile	Average equipment owned by household	
	TV sets	Independent recorders
<i>Single occupant</i>	2	1
<i>Retired couple</i>	2	1
<i>Young family</i>	3	1
<i>Teen family</i>	3	1
<i>Low income teen family</i>	3	1

8 COST IMPLICATIONS OF SWITCHOVER

8.1 Household cost of switchover

Using the anticipated cost and equipment ownership profiles shown in Table 6 and Figure 2 - the total cost to a household of converting all TVs and recorders in the home by household type and region (assuming all equipment is purchased in the year of switchover) is shown in Figure 10.

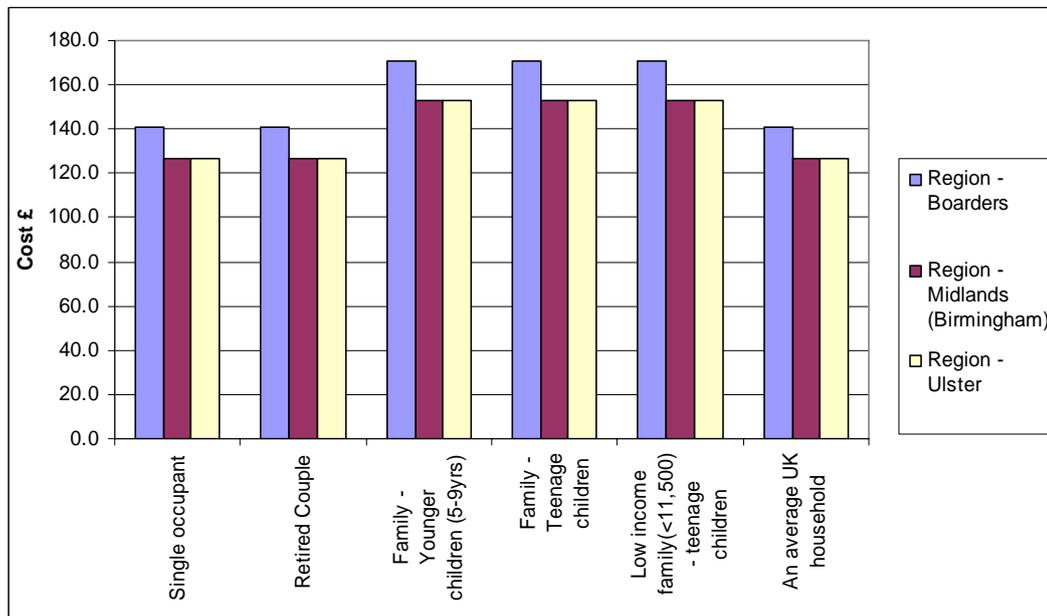
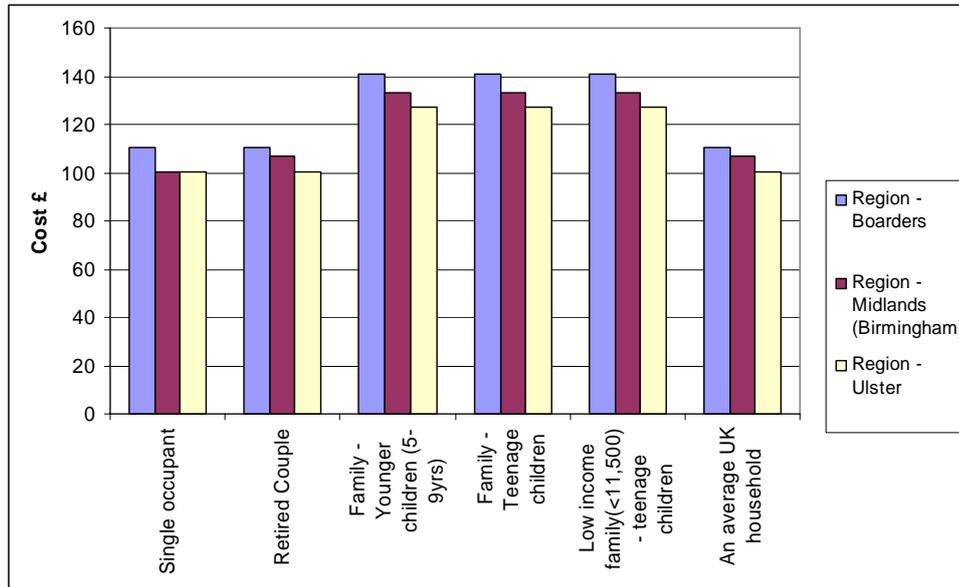


Figure 10 – Total household cost of set and recorder conversion by household type, by region (based on the average amount of equipment in the home from Table 6 rounded to the nearest whole number of sets & recorders)

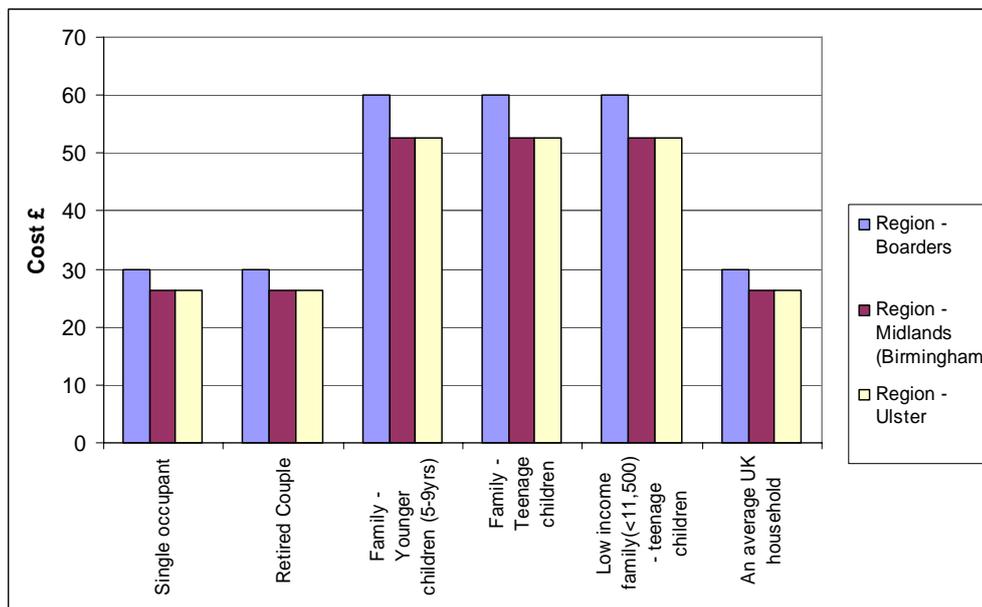
However, as discussed in section 7.1, many sets and recorders will have been converted voluntarily before switchover. To accurately reflect the impact of Government’s switchover policy (as against natural technology adoption), it is only the cost of non-voluntary conversions that is of relevance.

In reality, households will have voluntarily converted different amounts of their equipment based on the attractiveness of digital services to them. Our model predicts that around 60-75% of households will have voluntarily converted all of their reception equipment prior to switchover. This leaves 25 - 40% of households having at least one set or one VCR requiring conversion. Of these, the majority are expected to have only one set and/or one VCR remaining to convert. To explore the range of costs that a household can expect from switchover driven conversions, we have therefore considered two conversion scenarios: that a household has voluntarily converted only its main set and that it has also converted an independent VCR. Figure 11 shows that the cost of converting reception equipment (TV sets and independent VCRs) ranges from

£26 to £141 per household if at least one set has already been voluntarily converted.



a) A household with one set voluntarily converted



b) A household with one set and one VCR voluntarily converted

Figure 11- Example of costs per household of non-voluntary set and recorder conversion by household type and region (based on the average amount of equipment in the home from Table 6 rounded to the nearest whole number of sets & recorders)

Figure 11 includes the cost of conversion of all sets & independent VCRs not voluntarily converted prior to switchover.

8.1.1 Aerials

As discussed earlier in this document, the majority of households needing new aerials to receive DTT today, will be able to use their existing aerials once the power of transmitters has been increased at the time of switchover.

As is the case with sets, for the purposes of understanding the implications of switchover, it is only non-voluntary aerial replacements that are of interest. The replacement of an aerial is only considered to be non-voluntary where the conversion of the set it feeds is non-voluntary.

It is therefore expected, that only around 2% of households will be required to install a new rooftop aerial once switchover has taken place. The cost of a replacement rooftop aerial is estimated to be £125²¹ with little or no price reduction expected over the next few years. This cost would therefore be additional to those shown in Figure 10 for the 402,000 households that fall into this category.

In total, 52% of all set top aerials will need to be replaced (mainly due to coverage limitations), with 96% of these being attached to subsequent sets. As a result of switchover, 11.4% (2.7m aerials) of set top aerials will be required to convert in order to maintain reception. Of those required, 25% (670,000 aerials nationwide) will need to be replaced with a feed from a roof aerial. The additional cost of this is expected to be approximately £50 for professional wiring and installation. The remainder of aerials that will need replacing (2m aerials) will need replacing with new digital set top aerials. The cost of this is estimated to be around £20 per aerial.

The total additional consumer spend due to non-voluntary aerial replacement is therefore estimated to be £123m.

8.2 National cost of switchover

The total consumer equipment cost that can be attributed to the UK's switchover policy (i.e. due to non voluntary conversion of equipment and aerials) at a national scale is expected to be approximately £449m with an additional £123m on aerials and related installations.

Table 8 shows a breakdown of national non-voluntary consumer spend. Figure 12 shows the annual non-voluntary spend by consumers for switchover

²¹ Based on interviews with installers

Table 8 - Breakdown of non-voluntary consumer spend, national 2008 – 2012

	2008-12
Primary sets	£76m
Subsequent sets	£143m
Recording devices	£230m
Aerials	£123m
Total	£ 572m

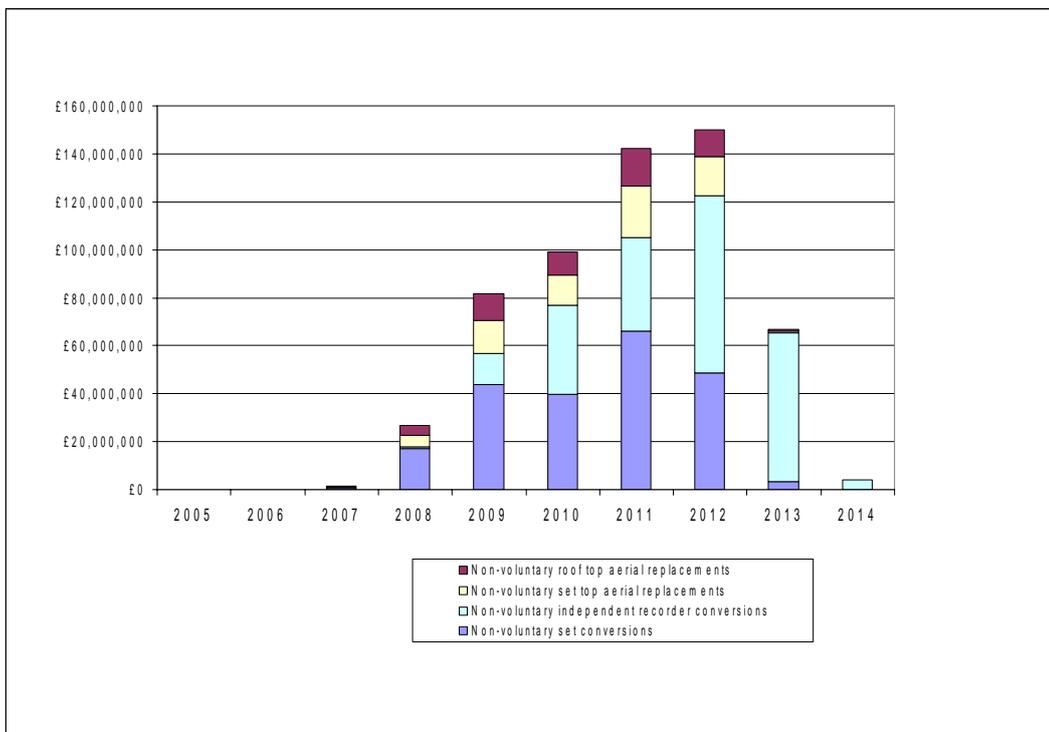


Figure 12 - Annual non-voluntary consumer spend in preparation for switchover

Figure 12 includes the annual cost of:

- Non-voluntary set conversions
- Non-voluntary recorder conversions
- Non-voluntary rooftop and set top aerial replacements.

9 POWER CONSUMPTION IMPLICATIONS OF SWITCHOVER

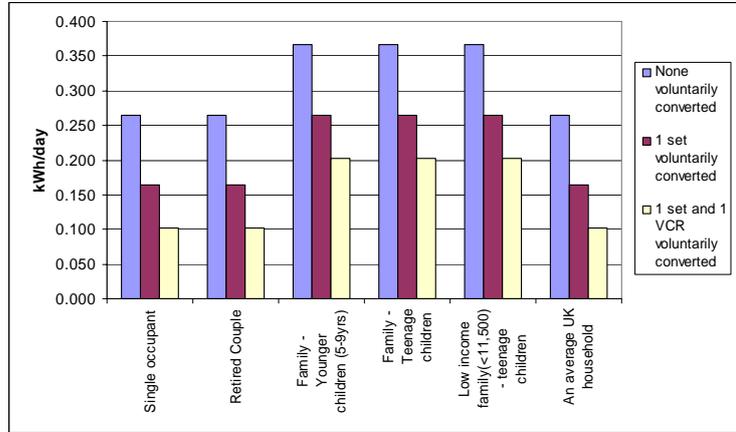
9.1 Household power consumption

Conversion to digital at the time of switchover will require (in most cases) new equipment to be added to the home (STBs). Inevitably, this will increase the amount of power consumed by a household. At a household level, the implications of this will be small, but are still noteworthy. Figure 13 shows the difference in power consumption that can be expected by a range of typical UK households in our three example regions as a direct result of conversion to digital TV. In the case of later conversions (Birmingham and Ulster), the effect of digital recorders becoming more power efficient than VCRs is apparent. In these years, looking at the incremental power consumption of new equipment clearly demonstrates that having to convert a VCR can actually reduce the incremental amount of power used by a household.

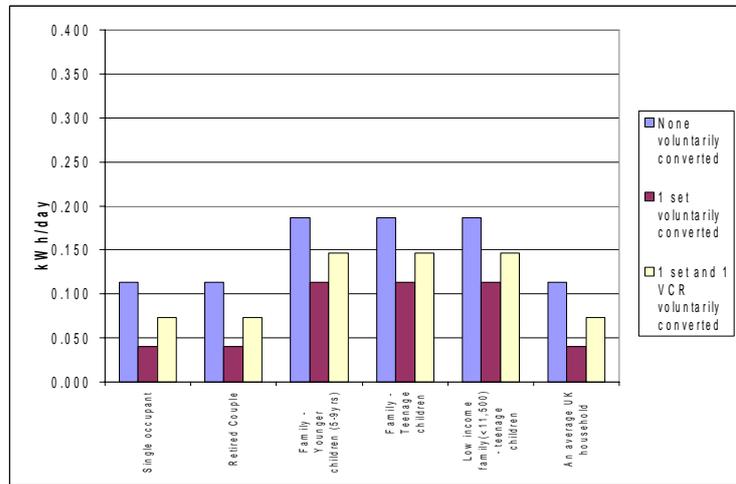
The model predicts that overall household power consumption will increase due to non-voluntary conversion of equipment. The level of this increase will depend on both the timing of switchover for that household and the level of voluntary conversion that has already taken place. However, over the whole of the switchover period, typical household power consumption is expected to increase by around 0.1 - 0.4kWh per day. With typical household power consumption in the UK running at approximately 4700kWh²², this is an increase of 0.006%. This represents an additional household electricity cost of approximately 0.5p - 2.2p per day (approximately £2 - £8 per year).

Despite this early demand for power, as technology develops and existing power hungry equipment such as VCRs are replaced with newer, more efficient products, it is expected that total additional power usage in the home due to switchover will trend towards zero.

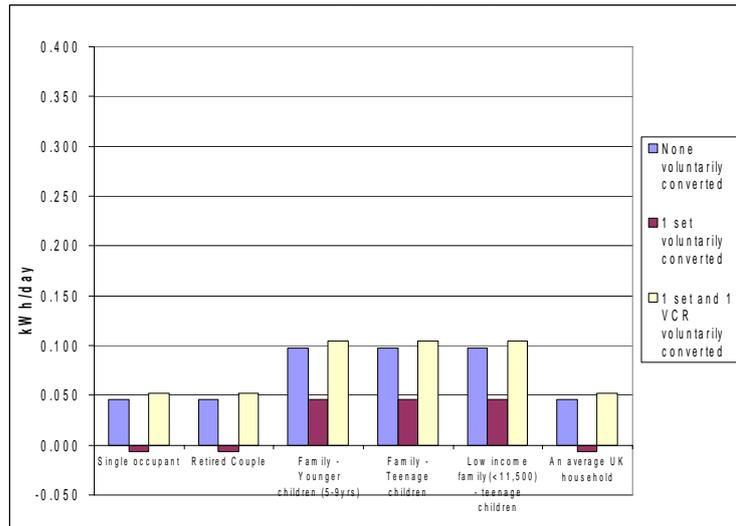
²² "Digest of UK Energy Statistics", DTI, 2002



Borders (2008)



Birmingham (2011)



Ulster (2012)

Figure 13 - Additional power consumption due to non-voluntary household conversion to DTV by region and by status of voluntary conversion

9.2 National power consumption

The baseline for our assessment of power consumption has been set as the government's announcement of switchover in September 2005. We have not sought to calculate the power consumed by all of the STBs and IDTVs already installed by this point because to do so would have been outside our terms of reference.

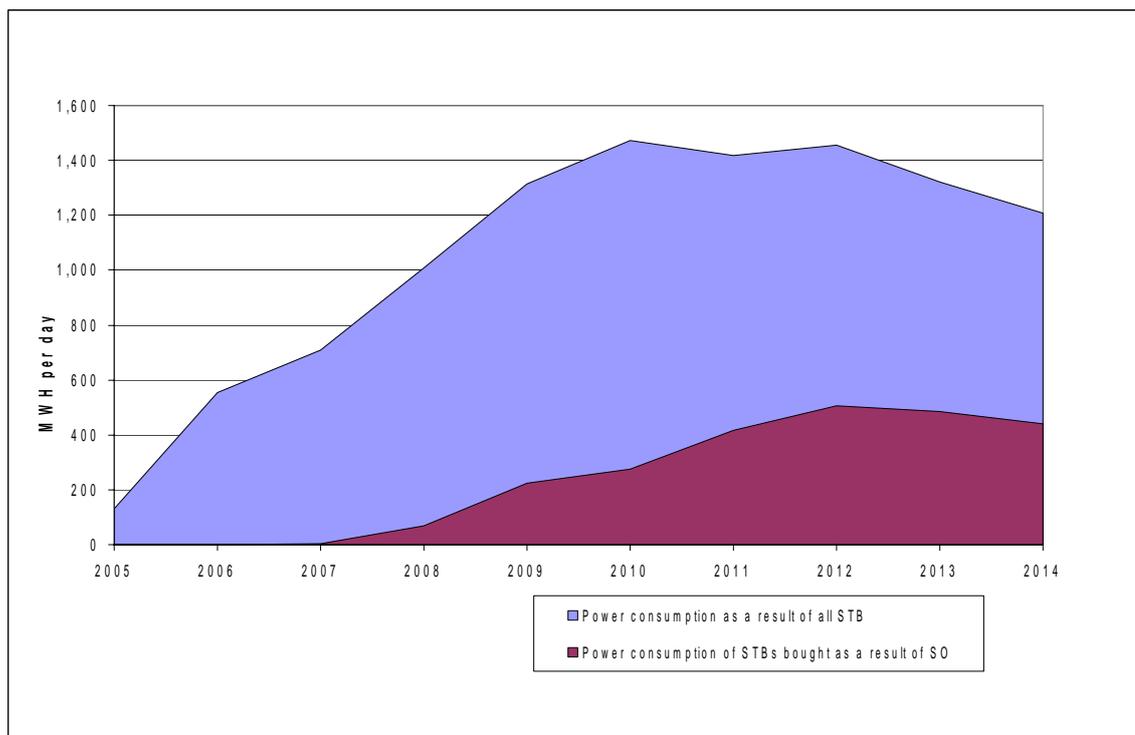


Figure 14 shows the total national power consumption by STBs and IDTVs that will be installed *following the switchover announcement*. We have distinguished between voluntary and non-voluntary conversions.

From the time of announcement, the additional power demand from STBs and IDTVs can be expected to increase to a peak of around 1,450 MWh/day. However, towards the end of the switchover process, the graph changes direction. This is because technology advances will result in each new set top box consuming less power.

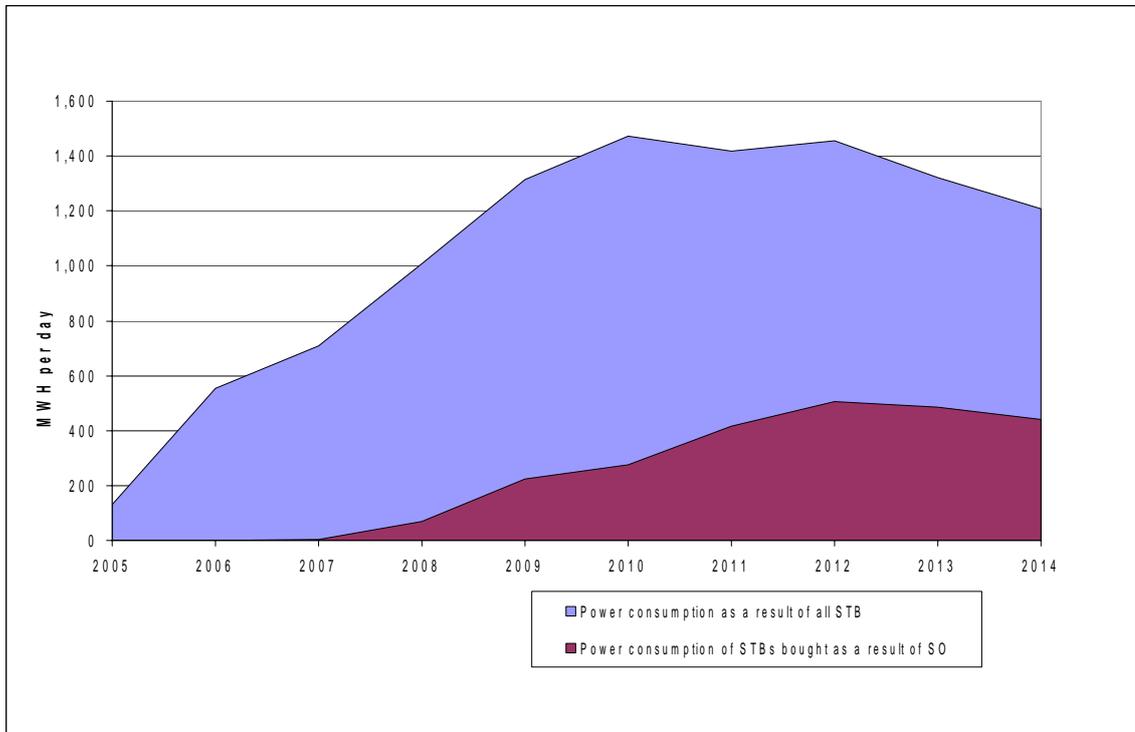


Figure 14 – Additional national power consumption by digital TV equipment installed after announcement of switchover in September 2005

Figure 14 shows *additional* power consumed by:

- All STBs installed following switchover announcement in September 2005 (those that are classed as non-voluntary are highlighted on the figure)
- IDTVs (as an increment over that consumed by an existing analogue TV).

Figure 15 shows that a reduction in absolute power consumption from recorders can be expected as VCRs are replaced with more power efficient digital recorders.

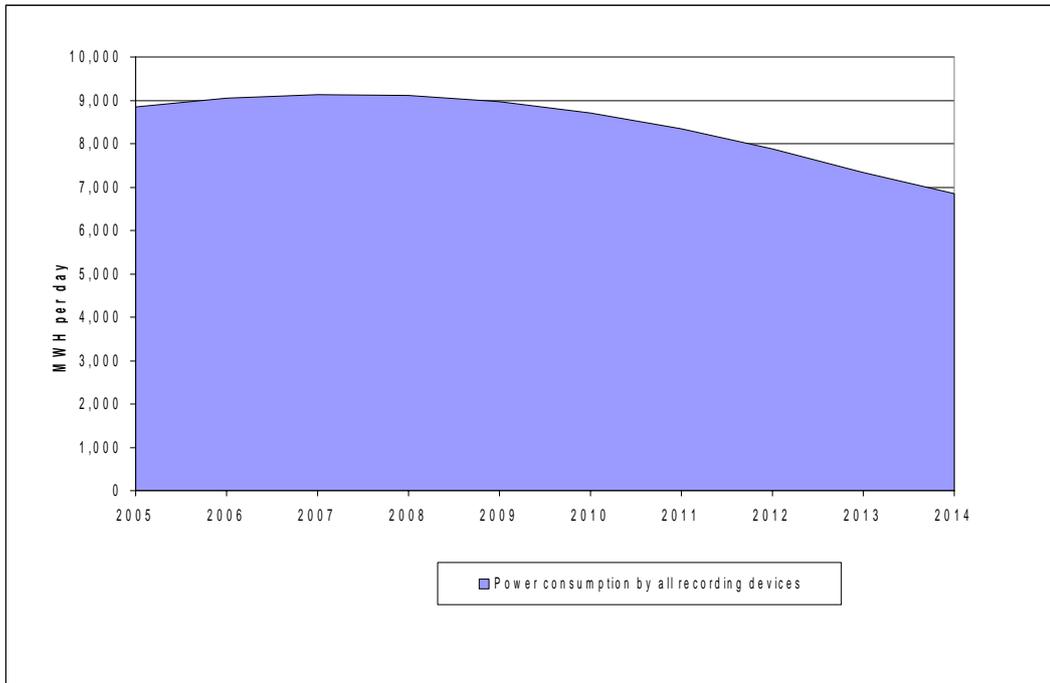


Figure 15 - National power consumption by all recording devices (converted or unconverted) to 2014

Figure 16 shows that the combined effect of non-voluntary conversions (either sets or recorders) is a net increase in national power consumption, peaking at a need for an additional 433 MWh/day. However, the switchover process will result in a power saving associated with switching off analogue transmitters. This saving has been estimated by Ofcom to be approximately 147GWh/year (402 MWh/day)²³. Combining the increased consumption from household equipment *that is not voluntarily converted* and the saving from transmission efficiencies therefore shows a net increase of 31 MWh /day which is approximately equivalent to 0.009% of total current UK domestic power consumption (taken to be approximately 322 GWh / day²⁴). In effect, this is the same as each UK household running a child's nightlight for around ten minutes each day²⁵.

²³ Ofcom internal assessment, 2003

²⁴ DTI Energy website (www.dti.gov.uk/energy)

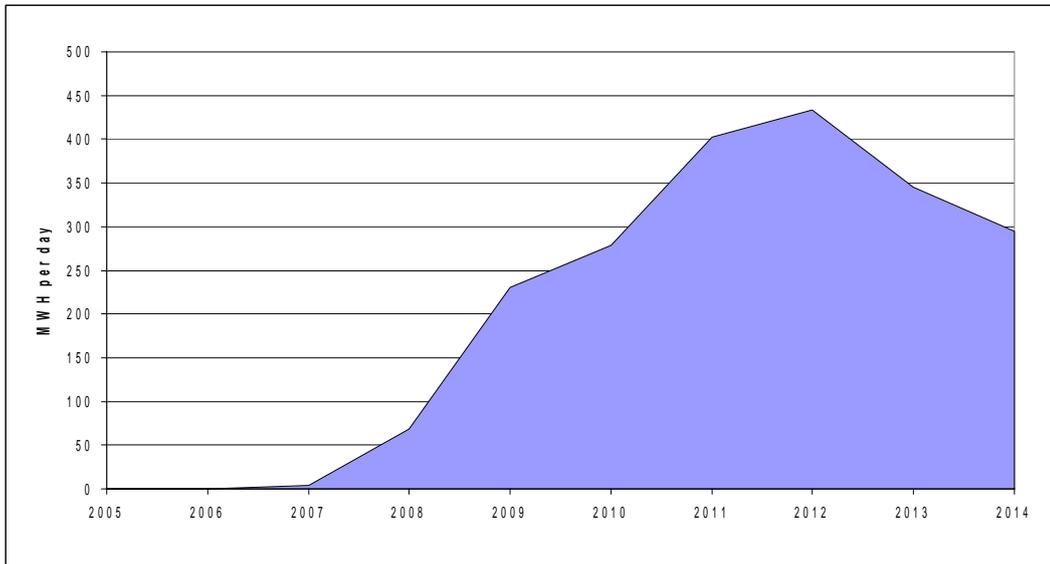
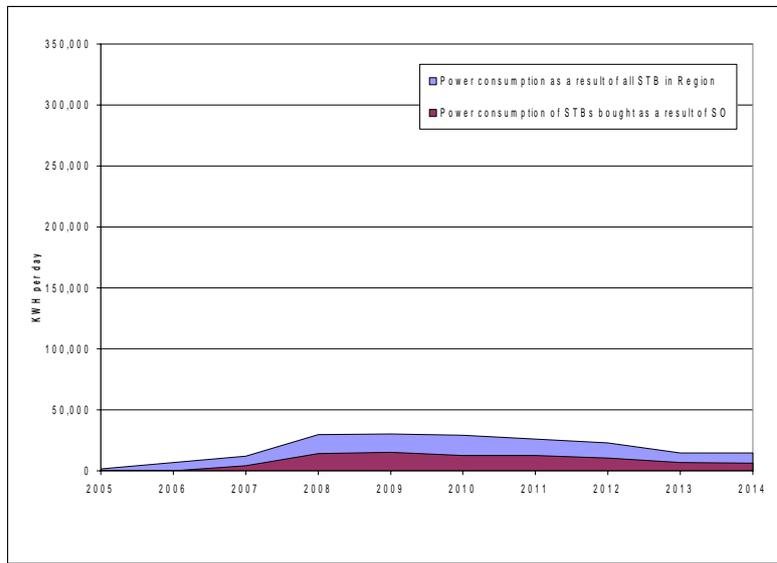
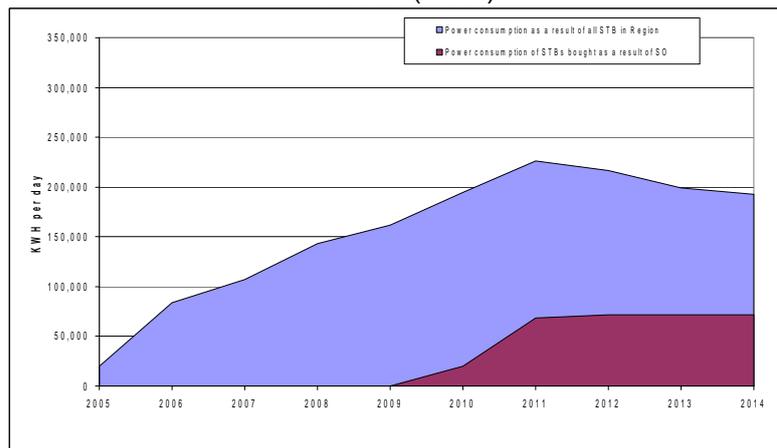


Figure 16 - Total additional national power consumption due to *non-voluntary* STBs and recorders

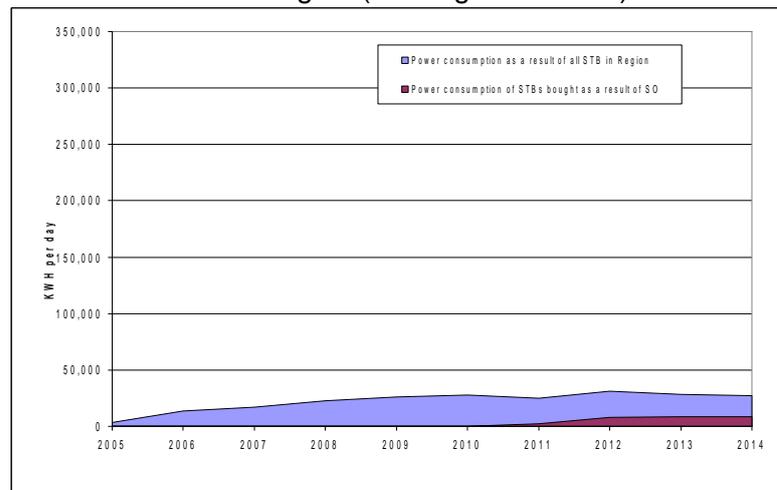
Figure 17 shows that the same general pattern holds when considered for STBs at a regional level for Borders, Midlands (Birmingham) and Ulster. As expected, the peak in power consumption falls in line with the proposed switchover date for each region.



Borders (2008)



Central region (Birmingham - 2011)



Ulster (2012)

Figure 17 -Regional power consumption by digital TV STBs

10 CONCLUSIONS

- 1 **Equipment costs.** Of all the available platforms, the cost to the consumer of a DTT STB is expected to see the most significant price reduction between now and the end of switchover. As the assumed lowest cost option, the cost of a DTT STB priced at around £50 in 2005 has therefore been estimated to fall to around £25 by 2012²⁶. Similarly a DTT recorder currently priced at approximately £180 is anticipated to cost around £80 by the first switchover in 2008 and remain at this price throughout switchover.
- 2 **Primary sets.** There are 24.8m primary sets in the UK. Currently some 60 percent of these sets receive DTV (14.9m households). This is increasing by approximately 6 percent (1.5m households) per year. By the time they find switchover upon them, we expect that around 90 percent (22.4m households) will have decided to convert their primary sets voluntarily or naturally (driven above market rates by increased awareness of digital as a result of government announcements and word of mouth as well as by normal television set replacement cycles and increasing availability of iDTVs). Therefore, around 10 percent of the sets will remain to be converted. Over the entire switchover programme our model predicts that around 8 percent of primary sets (approximately 2m households) will be non-voluntarily converted. The total cost will be £76m.
- 3 **Subsequent sets.** There are 24.3m regularly used subsequent sets in use in the UK. Currently some 28 percent of these sets receive DTV. When the first regions switch in 2008, around 50 percent will have been converted, 21 percent will still need to be converted and 29 percent will not be converted. By 2012 the proportions will have changed to 57 percent, 14 percent and 29 percent respectively. Over the entire switchover programme 16 percent of subsequent sets (3.9m) will be non-voluntarily converted. The total cost will be £143m.
- 4 **Recording devices.** There are 30m recording devices in the UK. Of these, 25% (7.5m) are used for 'independent recording' at least once per month (recording a channel other than that being watched, or in circumstances where the recorder requires control of the channel being recorded). Digital recorders are still embryonic and current penetration is taken to be around 3%, however is not significant in the context of this study. Over the entire switchover programme, 40% of independent recorders (3.1m devices) will be required to convert due to switchover. The total cost will be £230m.
- 5 **Aerials.** 52% of existing set top aerials will need to be replaced by digital set top aerials (£20 each) or a connection to a rooftop aerial (£50 to connect to an existing aerial). However, because transmission power levels will increase after switchover, only an estimated 2% of households will face non-voluntary replacement of their rooftop aerial at £125 per installation. The total cost will be £123m.

²⁶ In line with "Supporting the most vulnerable consumers through digital switchover", Ofcom Consumer Panel, November 2004

- 6 **Total costs to UK households.** The total non-voluntary cost to UK households of the switchover policy is estimated to be around £ 572m.

	2008-12
Primary sets	£76m
Subsequent sets	£143m
Recording devices	£230m
Aerials	£123m
Total	£572m

Total costs to UK households

- 7 **Non-voluntary set conversion.** An estimated 60-75% of UK households are expected to have voluntarily converted all of their equipment prior to switchover. As a result, these households will incur no cost as a result of digital switchover. Of the rest, the majority are expected to have only one set and/or one VCR needing conversion. The lowest cost of converting equipment at switchover will be around £25 for a set and £80 for a VCR.
- 8 **Actual household costs.** For those households that will incur a cost as a result of switchover, the actual cost will depend on the equipment requiring conversion and the level of voluntary conversion carried out before switchover.
- Typical non-voluntary costs for TVs and recorders in households containing an average collection of reception equipment are therefore estimated to range from £26 to £153.
 - Where set top aerials are used, around 50% of them are expected to need replacement at a cost of £20-40 per household - bringing the range of cost for these households to £46 - £193.
 - For households requiring a new roof aerial a further cost of around £125 will be experienced however this only applies to an estimated 2% of households.

Household type [†]	Percentage of UK households	Status of voluntary conversion at switchover			Range of equipment conversion costs*
		None already converted	1 set already converted	1 set & 1 VCR already converted	
Single occupant	31%	£127	£100	£26	£26 - £127
Retired couple	12.3%	£127	£100	£26	£26 - £127
Young family (with children 5-9 years)	8.5%	£153	£127	£53	£53 - £153
Teenage family (with children 10-14 years)	9.4%	£153	£127	£53	£53 - £153
Low income teenage family	1.5%	£153	£127	£53	£53 - £153
An average UK household	100%	£127	£100	£26	£26 - £127

Range of typical non-voluntary costs experienced by a household containing an average collection of reception equipment (by household type and level of voluntary conversion - 2011 equipment prices assumed)

[†] Selected example Household types of interest to Ofcom

* Based on a household containing an average amount of reception equipment for that household type. It is recognised that where households have more than the average amount of equipment they may experience a cost outside of this indicative range.

** Table excludes cost of rooftop or set top aerial replacement

9 **Power consumption.** The additional power consumed by the digital equipment required in the home due to switchover will peak in 2012 but will then fall of as older set top boxes are replaced with newer units which consume less power in both operating and standby modes. Our model predicts that the average household will consume an extra 0.1 – 0.4 kWh/day as a result of non-voluntary conversions. Approximately equivalent to running a 60W light bulb for 1.5 to 6.5 hours/day. The total cost to the household of this additional power usage is expected to be approximately 0.5 – 2.2p per day (£2 - 8 per year).

10 **National power consumption.** The additional national power requirement to meet the demands of non-voluntary conversions in UK households is estimated to peak at approximately 433 MWh/day in 2012. This is offset by the reduction in transmission power which has been estimated by Ofcom to

be 147 GWh/year (402 MWh/day) – a net effect of 31 MWh /day which is approximately equivalent to 0.009% of total current UK domestic power consumption (taken to be approximately 322 GWh / day²⁷). In effect, this is the same as each UK household running a child's nightlight for around 10 minutes each day²⁸.

²⁷ DTI Energy website (www.dti.gov.uk/energy)

²⁸ National power consumption findings are in line with an independent study for DEFRA: “*UK Energy Consumption of Domestic Terrestrial Digital Television Adaptors*”, Market Transformation Programme, 2005

APPENDIX A SUMMARY OF MODEL STRUCTURE

This section of the report outlines in brief some of the major elements of the model, their structure and key assumptions

A.1 Key inputs

The inputs to the model are constants. The various conditions and assumptions discussed in this report are included in the model as either part of the model structure or as sourced inputs. Should Ofcom wish to understand the impact of different scenarios, or to update the model as more data become available, these inputs will allow this to be done easily and transparently. Whilst it is not necessary to explicitly discuss every input in this report, this section describes some of the most complicated or critical inputs.

A.2 Regions

The model separately considers each of the 14 British broadcast regions (Meridian and Channel are modelled together in order to allow mapping to other existing datasets). The number of primary sets in each region is a key input and is computed from the number of households in the region and the findings of other studies. Whilst there is geographic overlap in the TV broadcasting regions, care has been taken to ensure that households are not double counted.

Data on the number of sets and recorders per household are key to forecasting the conversion needs of each region. This data has been taken from previous studies. Where regions do not precisely overlap between studies (i.e. The Generics CAPI dataset is split into 11 national regions rather than the 14 broadcast ones) profiles from the relevant national region are mapped onto data covering the broadcast regions.

Adoption profiles

The rate at which conversion will take place is a critical input to the model. These are modelled as 'profiles' defining the percentage of all equipment that will be converted per year.

Voluntary adoption profile – TV sets:

The number of primary sets converted voluntarily is modelled as a regional voluntary adoption profile. The voluntary adoption profile is created from 3 sources:

- Scientific Generics CAPI data
- A correction factor to account for increased awareness of digital TV since the CAPI survey was carried out (based on Ofcom digital quarterly report data)
- The number of end of life analogue TVs that are replaced with iDTVs

The profile is then adjusted according to the switchover date. Any households that are known from the CAPI research to plan to convert after the proposed switchover date are modelled as voluntarily converting during the year of switchover.

[Voluntary adoption profile - Independent recording devices](#)

For independent recording devices, the voluntary conversion profile is based on a percentage of the forecast sales of digital recording devices²⁹. The profile is used up to the year of switchover and unlike TV sets, predicted voluntary conversions after the switchover date are not brought forward. This is the case to ensure that continued natural technology adoption does not skew the results of a switchover focused model.

[Non-voluntary adoption Profile](#)

The non-voluntary adoption profile is created in two parts. Firstly the total number of sets non-voluntary to convert is calculated. This is the number of sets that will eventually convert to digital minus those who will have voluntarily converted by switchover.

Secondly this number is distributed over the two years before and one year after switchover. The number of non-voluntary conversion each year, relative to the switchover date, is then calculated. A similar approach is taken for independent recording devices.

Power consumption and drivers

As part of this programme of work a range of set top boxes and recording devices were tested in order to determine their real world power consumption characteristics in operating and standby modes. The predicted future power consumption of set top boxes and recording devices was then estimated based on limited industry interviews, Scientific Generics technical knowledge and a firm understanding of the technologies in the devices. Power consumption profiles were then created for set top boxes and recording devices, the profiles provide power consumption figures for a device bought in any given year.

Cost drivers

A cost profile was also created to provide the predicted future cost of a device bought in any given year. Current market prices were considered and a cost forecast was created through looking at the technology required in a device, speaking to manufacturers and understanding market drivers. The model uses a fixed cost for roof top aerial replacements, set top aerial replacements and additional roof top feeds (to subsequent sets).

²⁹ Generics analysis of multiple sources: “*The impact of announcing analogue switch-off on UK retailers and Manufacturers*”, Opta, March 2004; “*UK Digital Television report 2002*”, New Media Markets, 2002, www.informamedia.com; “*New video recorders threaten TV advertisers*”, Thursday, January 20, 2005, Media Network Weblog, www.medianetwork.com; “*HHD Recorder market*”, PVR UK, 2005, www.pvruk.co.uk

A.3 Assumptions

This section outlines the set of core assumptions made in the model. Each of these is represented as either an input or as a structural element of the model itself. The specific implications of these assumptions on the final output of the model are not discussed here, but are highlighted in the report if relevant.

General

- Switchover and announcement occur at the end of their respective years
- Assumed rates of conversion do not take in to account unforeseeable disruptive technologies

Sets

- The total UK market for primary sets is saturated being driven only by set replacement
- The distribution of 'number of sets per household' is constant. i.e. percentage of 3-set households will not increase or decrease
- Set replacement is a constant at approximately 10% per year
- IDTV sales will grow; All new primary sets will be IDTVs by 2012
- All non-voluntary conversions will take place in the two years before switchover, or within a year after switchover
- A small proportion (5%) of non-voluntary conversions will happen in the year after switchover as viewers miss access to TV.
- Any voluntary conversions that a household actively plans to make but which will fall after their region is switched over will be brought forward and made voluntarily in year of switchover
- Anticipated end of life replacements occurring after switchover are not brought forward as a result of switchover
- Voluntary adoption without switchover is based upon analysis of Scientific Generics' CAPI questionnaire data and Ofcom digital quarterly reports.
- Voluntary conversion will be driven by general awareness of DTV

Recording devices

- Voluntary conversion of VCRs will take place through replacement with suitable digital recorders
- Non-voluntary conversion of VCRs that are used to record independently are to be replaced with a digital video recorder
- Only VCRs that are currently used on a regular basis (more than once in 2 weeks) for independent recording will require dedicated conversion
- VCRs used to record (but not independently) will be converted through the primary set's STB

- VCR usage patterns are uniform by region
- Adoption of digital recorders occurs uniformly across all regions

Aerials

- Only 10% of roof aerials will require replacement to receive PSB's over DTT after switchover
- 52% of set top aerials will need to be replaced with alternative 'digital compatible' aerials (set top or roof top) to receive DTT
- 25% of set top aerials that need replacement will require connection to a roof aerial to receive DTT

Power Consumption

- A TV set spends an average of 4hrs in operating mode per day
- Digital recorders are used as a replacement for VCR's - STBs are not considered a realistic option for VCRs for independent recording
- DVD-r and PVRs have comparable power consumption rates (based on Scientific Generics measurements)
- Digital recorder power consumption in standby mode will decrease over time due to developments
- VCR power consumption is fully developed and will not change
- iDTVs have comparable power consumption to current analogue TVs
- For the power calculation the installed base of digital sets has been modelled as sets converted in 2003 and 2004

Costs

- STBs will experience a price reduction over time
- Non-voluntary conversions of TV sets will be enabled by low end STBs where possible, if the household is unable to receive PSBs over DTT after switchover FTV satellite will be used
- The cost of non-voluntary conversions using FTV satellite will be modelled as the cheapest of the available options, 'Sky-Free View' or 'In the Clear'
- Digital recorders will reduce significantly in price
- Cost of converting to DTT by purchasing an iDTV is calculated as the average difference in cost of an iDTV and an analogue TV in that year (based on Generics estimates)
- Cost of roof top aerial replacement will remain constant

A.4 Summary of model structure

The conversion model

The conversion model is split in to 3 sections: TV sets, recording devices and aerials. TV sets are split further into primary and subsequent sets, the model logic for primary and subsequent sets is identical and each part is fed with the relevant inputs.

Primary sets

The conversion model starts by considering how many primary sets are in use in the region. The installed base of digital households (taken from Ofcom data) is used to calculate the forecast number of sets remaining to be converted.

The voluntary conversion adoption profile is used to calculate the number of voluntary conversions in any given year. Should any voluntary adoptions be planned for after switchover, the profile is automatically altered such that all voluntary conversions occur before the switchover date. Next, the model calculates the total number of sets that will not be converted through voluntary adoption; these sets are considered to be non-voluntary conversions. The non-voluntary conversion adoption profile will then calculate the number of non-voluntary conversions in any given year relative to the switchover date.

The total number of conversions in a year is given by the sum of the voluntary and non-voluntary conversions, and is split by platform using platform growth forecasts. Finally the model calculates the number of Freeview set top boxes, for primary sets, bought in any one year.

Subsequent sets

Subsequent set conversions are calculated using the logic described above for primary sets, however, in this case the total number of subsequent sets in a region is calculated using Scientific Generics' CAPI data.

Recording Devices

Recording device conversions are calculated using the same logic as TV sets, however, the model is only concerned with recording devices which are used for independent recording (i.e. those used to record a channel not being watched at least once per fortnight).

Recording devices are connected to both primary and subsequent sets and many are used only for playback and thus do not need a live TV feed; therefore not all independent recorders will be converted to digital recorders. The total number of recording devices to be converted is calculated as follows,

- Total number of VCRs in the region = sum of devices on primary and subsequent sets
- Number recording devices that are used to independently record

- Number of independent recorders that will be converted to digital eventually

As with TV sets the number of devices remaining to be converted is calculated for each year. Using the voluntary conversion profile, the number of voluntary conversions is added to the digital installed base annually.

The model then calculates the total number of VCRs that will not have been converted through voluntary adoption by switchover - these are considered non-voluntary conversions. The non-voluntary conversion adoption profile will then calculate the number of non-voluntary conversions in any given year.

Aerials

The last part of the conversion model calculates the number of aerials that will be converted as a result of switchover. Therefore, this section looks only at aerials attached to sets which are required to convert.

The model calculates the number of roof top aerials attached to sets required to convert and then calculates the number of roof top aerials to be converted as a result of non-voluntary conversions.

Further, the model calculates the number of set top aerials attached to sets required to convert. The number of set top aerials (STAs) to be converted / replaced is then calculated taking account of the proportion that will continue to work after switchover.

Lastly the number of set top aerials that need to be converted is split into:

- Number of STAs that need to be replaced with roof top aerial links
- Number of STAs that can be replaced with new STAs.

The power model

The second section of the model uses the outputs from the conversion model to analyse the power consumption implications of switchover. This model takes account of platform, age of device and periods of use and standby to investigate how much power a device will consume. The breakdowns generated in the conversion model are then used to calculate how total regional and national power consumption will change as a result of switchover.

The cost model

The third section of the model uses the outputs from the conversion model to analyse the cost implications of switchover. The model takes into account platform and year of conversion. Using the cost profile the model generates an annual cost of conversion by region. In the case of TV sets and recording devices, annual costs are calculated for non-voluntary and total conversion. Finally the cost model uses outputs from the conversion model to calculate the cost of aerial conversion, by region, for sets that are required to convert.

APPENDIX B REFERENCES & SOURCES

B.1 Acknowledgements

We would like to acknowledge the following organisations that provided us with useful information:

- Which?
- Philips
- ST Micro

B.2 Core data set

The core data used during this study was Scientific Generics CAPI dataset. This contains data on the results of face to face interviews with a 1500 person representative sample of end users. This dataset was generated as part of The Generics Group's study on the human aspects of digital switchover, carried out between April 2003 and March 2004.